Institute for Materials Science

UNCLASSIFIED

IMS Lecture Series

Professor Yuli Lyanda-Geller
Department of Physics and Astronomy
Purdue University, West Lafayette IN

Topological Matter in Charge Carrier Hole Systems

Tuesday, June 28, 2016
10:00 to 11:00 am
MSL Auditorium (TA-03 - Bldg 1698 - Room A103)

Abstract: The discovery of quantum Hall effects and other topological phenomena has transformed our knowledge of condensed matter. Topological states of matter are crucial for fault-tolerant quantum computing. Initially study of topological phenomena was focused on simple electron systems, but recently it was realized that spin-orbit effects in band structure can lead to new topological states. The strongest spin-orbit coupling arise in the spin 3/2 semiconductor systems, which have unique potential for control of spectra and topological matter.

I will discuss topological effects in charge carrier hole quantum wells and wires. Here, a mutual transformation of heavy and light holes upon reflection from hetero-boundaries is important for understanding g-factors, spin-orbit constants and cyclotron masses. I will show that in a proximity of a superconductor, hole wires are a promising setting for an observation of the Majorana fermions. Furthermore, in the Fractional Quantum Hall effect, an incompressible state emerges at half filling of the ground state of holes in a magnetic field, explaining recent experimental data. The wavefunctions of this state and excited states of the hole liquid have considerable overlaps with the wavefunctions of the Moore-Read Pfaffian state and its excitations, suggesting that such hole state is a non-Abelian matter.

Bio: Yuli Lyanda-Geller got his PhD from Ioffe institute, Russia, in 1987, studying photo-galvanic effects in crystals lacking symmetry center. He then continued his work at Ioffe Institute, becoming Senior Member of Technical staff. In 1989 he was awarded the USSR highest National Prize for Young Scientists – Lenin Komsomol Prize - for his work on transformation of an angular momentum into an electric current. The same year he predicted two phenomena, which later became known as spin-galvanic effect (electric current due to spin polarization of electrons) and Aronov-Lyanda-Geller-Edelstein effect (spin polarization of electrons by an electric current). In the 90th, he discovered spin-orbit Berry's phase in semiconductors due to the intrinsic Rashba and Dresselhaus spin-orbit interactions, and developed theory of weak localization and anti-localization, now known as Iordanskii-Lyanda-Geller-Pikus theory. He continued his work on spin-orbit interactions and geometric phases in Condensed Matter physics while at the University of Illinois at Urbana-Champaign and at the Naval Research Laboratory.

He is currently a Professor at the Department of Physics and Astronomy, Purdue University, West Lafayette Indiana. His most recent works are devoted to the Quantum Hall effect, topological states of matter in quantum Hall and hybrid superconductor/semiconductor systems. He has also worked on physics of excitons in semiconductors, quantum computing and decoherence in quantum dots, transport in ferromagnets and dilute magnetic semiconductors.

For general information contact Caryll Blount * IMS Administrator
caryll@lanl.gov * 665-3950

Hosted by Alexander Balatsky * Director of the Institute for Materials Science

Los Alamos NATIONAL LABORATORY EST.1943